CLAIMS

What is claimed is:

1. A steering control device for use in a vehicle having a steering wheel that receives steering input, and an electronically-controlled steering unit that turns the vehicle's wheels over a road surface based on the position of the steering wheel, comprising:

a reaction force device coupled to the steering wheel and responsive to a control signal to apply a steering reaction force to the steering wheel;

a hands-free sensor adapted to generate a signal indicative of whether the steering wheel is in a hands-on state or a hands-off state; and

a controller adapted to vary the control signal in response to the hands-free sensor signal to reduce the steering reaction force applied when the hands-off state is indicated relative to the steering reaction force applied when the hands-on state is indicated.

2. The steering control device of claim 1, further comprising:

a road surface reaction force sensor adapted to generate a signal indicative of road surface reaction force, wherein the reaction force device is further adapted to apply the steering reaction force corresponding to the indicated road surface reaction force; and wherein the controller is further adapted to reduce the steering reaction force corresponding to the indicated road surface reaction force when the hands-off state is indicated.

3. The steering control device of claim 1, further comprising a steering angle detection sensor adapted to generate a signal indicative of the steering angle of the steering wheel; wherein the steering reaction force device is further adapted to apply a steering reaction force corresponding to the steering angle; and wherein the controller is further adapted to reduce the reaction force corresponding to the indicated steering angle when the hands-off state is indicated.

4. The steering control device of claim 1, further comprising a steering angle acceleration detection sensor adapted to generate a signal indicative of the steering angle acceleration; wherein the steering reaction device applies a steering reaction force corresponding to the indicated steering angle acceleration; and wherein the controller is

further adapted to reduce the reaction force corresponding to the indicated steering angle acceleration when the hands-off state is indicated.

5. The steering control device of claim 1, further comprising a steering angle velocity detection sensor adapted to generate a signal indicative of the steering angle velocity; wherein the steering reaction device applies a steering reaction force corresponding to the indicated steering angle velocity; and wherein the controller is further adapted to reduce the reaction force corresponding to the indicated steering angle velocity when the hands-off state is indicated.

6. The steering control device of claim 1, further comprising a steering torque detection sensor adapted to generate a signal indicative of steering torque; and wherein the controller is further adapted to reduce the reaction force when the indicated steering torque decreases and the hands-off state is not indicated.

7. A vehicle having road wheels, comprising:

a steering unit;

an electronically-controlled turning unit responsive to the steering unit which turns the road wheels based on the position of the steering unit;

a steering reaction force applicator adapted for applying a steering reaction force to the steering unit;

a hands-free sensor adapted for detecting whether the steering unit is in a hands-off state or a hands-on state; and

a steering reaction force correction component adapted for reducing the steering reaction force applied when the hands-off state is detected relative to the steering reaction force applied when the hands-on state is detected.

8. The vehicle of claim 7, further comprising:

a road surface reaction force sensor adapted for detecting the road surface reaction force; wherein the steering reaction force applicator applies a steering reaction force corresponding to the road surface reaction force; and wherein the steering reaction force correction component reduces the steering reaction force corresponding to the road surface reaction force when the steering unit is in the hands-off state.

9. The vehicle of claim 7, further comprising a steering angle detection sensor for detecting the steering angle of the steering wheel; wherein the steering reaction force applicator applies a steering reaction force corresponding to the steering angle; and wherein the steering reaction force correction component reduces the steering reaction force corresponding to the steering angles when the hands-off state is detected.

10. The vehicle of claim 7, further comprising a steering angle acceleration detection sensor for detecting the steering angle acceleration; wherein the steering reaction force applicator applies a steering reaction force corresponding to the steering angle acceleration; and wherein the steering reaction force correction component reduces the steering reaction force corresponding to the steering angles when the hands-off state is detected, but reference steering angle acceleration.

11. The vehicle of claim 7, further comprising a steering angle velocity detection sensor adapted for detecting the steering angle velocity; wherein the steering reaction force applicator applies a steering reaction force corresponding to the steering angle velocity, and wherein the steering reaction force correction component reduces the steering reaction force corresponding to the steering angle velocity when the hands-off state is detected.

12. The vehicle of claim 7, further comprising a steering torque detection sensor adapted for detecting steering torque; wherein the steering reaction force correction component reduces the steering reaction force when the steering torque becomes smaller if the hands-off state is not detected.

13. A vehicle for controlling road wheels of the vehicle comprising:

means for turning the road wheels in response to a steering input of a steering unit;

means for applying a steering reaction force to the steering unit;

means for detecting whether the steering unit is in a hands-on or hands-off state; and

means for reducing the steering reaction force in the hands-on state when the hands-off state is detected.

14. A method for controlling the road wheels of a vehicle comprising:

turning the road wheels from a steering input via a steering unit;

applying a steering reaction force to the steering unit;

detecting whether the steering unit is in a hands-on or hands-off state; and

reducing the steering reaction force applied when the hands-off state is detected relative to the steering reaction force applied when the hands-on state is detected.

15. The method of claim 14, further comprising;

detecting a road surface reaction force;

applying a steering reaction force to the steering unit corresponding to the road surface reaction force; and

reducing the steering reaction force corresponding to the road surface reaction force when the hands-off state is detected.

16. The method of claim 14, further comprising:

detecting the steering angle;

applying the steering reaction force to the steering unit corresponding to the steering angle; and

reducing the steering reaction force corresponding to the steering angle when the hands-off state is detected.

17. The method of claim 14, further comprising:

detecting the steering angle acceleration;

applying the steering reaction force to the steering unit corresponding to the steering angle acceleration; and

reducing the steering reaction force corresponding to the steering angle acceleration when the hands-off state is detected.

18. The method of claim 14, further comprising:

detecting the steering angle velocity;

applying the steering reaction force to the steering unit corresponding to the steering angle velocity; and

reducing the steering reaction force corresponding to the steering angle velocity when the hands-off state is detected.

19. The method of claim 14, further comprising:

detecting the steering torque;

applying the steering reaction force to the turning means corresponding to the steering torque; and

reducing the steering reaction force corresponding to the steering torque when the hands-off state is detected.